An Analysis of the Hong Kong Building Regulations Utilizing an Interactive format

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This paper is intended as a supplement to a live demonstration of an interactive matrix built to accommodate the Hon- Kong Building Ordinances and Regulations. The matrix employs a multimedia system developed by the Department of Architecture, University of Hong Kong and allows a multivariable approach to comprehending and analysing the laws that influence the design and construction of buildings in Hong Kong.

Keywords: interactive matrix; multimedia; building regulations;-3D *models,- components.*

1 Introduction

For the past three years the Department of Architecture, University of Hong Kong has been developing interactive multimedia with real-time 3D modelling as the pivotal element of its computer research. This paper is an exploration of the application of this multimedia system to the Hong Kong Building Regulations by the construction of a three dimensional matrix for navigation, comparison and analysis. The original system has reached an advanced stage of development and it is now being used for teaching, research and practice. Each of the 3D models is composed of groups of components in OOM format so that hyperlinks can be attached to the group as a whole or to individual components. The intent of the developers is to offer the maximum flexibility to both authors and users by permitting the creation of structured or random access paths through the database. Authoring is a two tier arrangement with staff establishing the outline paradigm and students building the system within this framework. At an early stage of development it was realized that if true interactivity with complex real-time 3D models was to be achieved then a relatively sophisticated delivery platform would be required. To this end SGI workstations running UNIX based Inventor, Open Inventor and Showcase software were chosen because of the on-board graphics capabilities and the overall speed of the machines.

2 What is an Interactive Matrix?

This modelling system is a multi-dimensional grid representing a range of related attributes within a time context. It relates written legal statements to their resultant physical built forms and places them in an historical time frame. Changes in the legal statements produce concomitant changes in the other layers of the matrix and these effects can be viewed at either a theoretical or applied level. Because the application of Building Regulations is not a discrete or monothetic process considerable complexity is involved in modelling the system. To keep the matrix to manageable levels of complexity a layering or hierarchical process is employed and thus only the requested relationships are normally displayed. This does not preclude the ability to have multiple databases open simultaneously but the default display opts for the lowest or simplest level of the hierarchy.

The matrix is infinitely expandable in all dimensions but in practice this is not necessary as the Building Regulations have a finite number of fields in they operate. The time axis is also limited as the earliest regulations date from the latter half of the nineteenth century and there are considerable intervals of time between subsequent enactments of the amended legislations [Refer to Figure 1].

The matrix acts as a structured navigation tool and presents the user with a summary view of the relevant ordinances and their dates, the major topics covered by the ordinances and the building enclosures or components affected by the regulations.

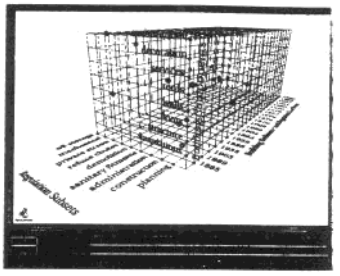

Figure 1: The Basic Matrix

3 The problem stated

With reference to the laws of Hong Kong the enabling legislation is usually vested in the Ordinance which, in the case of buildings, is currently Cap. 123. This document is relatively short and covers the general principles of the act. It contains a set of definitions and procedures and makes provision for the production of the regulations which are the definitive implementation tools of the law. These regulations are extensive and complex and require a high level of familiarity for their correct application. For simplicity in this paper the term Building Regulations will be used to cover both the Ordinance and the Regulations.

There are several levels at which the Building Regulations need to be comprehended. The first is at a theoretical level where the general principles are assimilated and where an overall appreciation of the objectives of the legal draftsmen is gained. At this time it becomes apparent that many of the Regulations are derivative and owe their existence to U.K. laws of the eighteenth and nineteenth centuries. This level requires that the general principles of the regulations can be represented in a diagrammatic and interactive manner rather than for site or building specific situations [Refer to Figure 2]. To permit this process the matrix has interactive pop-up windows that contain the relevant schedules and by the use of sliders animations represent the changes in the built form. With the three types of site classification used in Hong Kong comparisons can be made as heights, site coverage or plot ratios are altered [Refer to Figure 3]. Future developments will allow direct comparisons to be made with historical antecedents and this area of the matrix will provide a structured base for on going research.

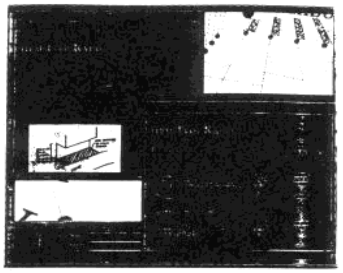

Figure 2 Diagrammatic Interactive Regulation

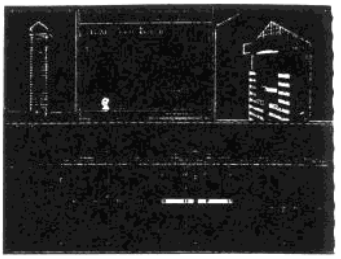

Figure 3 Schedules With Sliders

On an historical level coarse searches can be carried out to identify the different prototypical buildings from each ordinance/ regulation period. These buildings, which are real-time 3D models, can be defined by type viz. residential, commercial, industrial etc. and can, in turn, be hyperlinked to other databases such as 2D drawings, photos, videos or any other multimedia file within the system. A further level of analysis can be directed towards specific element searches which extract both written and physical references to the element. As the 3D model consists of a number of OOM components, each of these can be accessed by the search. The ability to recall comparable components from any 3D model is determined by the level of detail required to indicate the smallest entity definable by the Building Regulations.

4 Features and functions of the interactive matrix

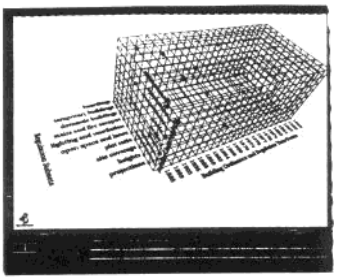

Figure 4 Relative Axes

The matrix is presented to the user as a transparent rectangular prismatic grid. The three axes represent the following: The X axis relates to the Regulation Subsets, while the Y axis relates to the Building Components which are a direct result of the

Ordinance and Regulations, and the Z axis indicates the Building Ordinance and Regulation Time Frame [Refer to Figure 4].

The number of subdivisions on the Y and Z axes has been kept to a minimum to reduce the matrix dimensions to manageable proportions. To permit this process a series of submatrices have been constructed. These submatrices remain hidden until the relevant subset is activated and once this occurs the main matrix retreats to a non-visible layer [Refer to Figure 5]. Occupied node points are indicated by spherical balls where information from the different planes coincides. As databases are established the node points will increase in density.

A user can extract a 2D plane of information out of the 3D matrix by specifying a value for one of the three axes of the 3D matrix e.g. if a user wishes to study how the Buildings and Nuisances Ordinance of 1856 affects matters and he has specified the ordinance as the value for the timeframe axis, the system will return him a 2D matrix containing all the subsets /components that are affected by this Ordinance. The 2D matrix also shows to which component /attribute each item/ subset belongs [Refer to Figure 6]. To go further the user can reduce the 2D matrix to a 1D linear list by specifying a value for one of the two axes e.g. if he wishes to study all the item/subsets that are governed by the Buildings and Nuisances Ordinance of 1856 which are part of the 'walls' for the building component axis a linear list containing all the item/subsets under walls and governed by the ordinance returns. This feature can narrow down the amount of information that is visible to the user by reducing the degree of freedom and thus can produce a convergence of required information optimally.

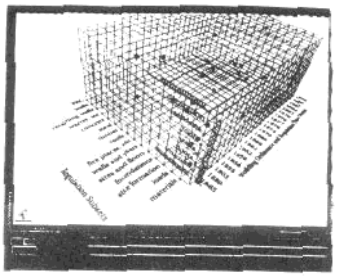

Figure 5 Construction SubMatrix

Each node represents a point of stored information and to invoke the release of this data a mouse-click launches the attached hyperlinks. The information can be a mix of different media interconnected by single or multiple hyperlinks and the retrieval of related information linkages to other nodes which are governed by the same regulation or which are categorised under the same component/ attribute is automatically activated.

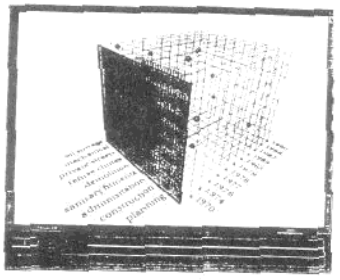

Figure 6 2D Matrix Section

5 Navigational aids

An intimate knowledge of the Building Ordinance and Regulations is not a prerequisite to using the matrix and a novice should have no difficulty in navigating his way through the system. The most obvious method of approach is through a point-and-click technique as familiarity builds the user will find the fastest methodology is to use the Subset-Component-Timeframe box located at the base of the screen [Refer to Figure1]. By typing in one two or three specifications a broad to fine search can be implemented.

A user can zoom in, zoom out, move and rotate the matrix to adjust the view. The text labels on the axes and the nodes automatically adjust themselves so that they always face towards the view plane of the user, no matter how the user changes the matrix's orientation. Also the level of detail of these labels increases /decreases as the user zooms in/out.

Tools such as link previewer, history list, and search facilities are available to assist navigation e.g. when the cursor enters the pick region of a node a preview window automatically shows the associated order triple for that node. To track a user's path a history list is kept showing all the visited nodes and these nodes can be revisited directly by selecting the corresponding entry in the list.

At the present time a detailed study of user interaction with the interfaces of the current multimedia system has been undertaken by the Department of Architecture, University of Hong Kong and these findings will be presented at the First International Cognitive Technology Conference to be held in Hong Kong in August, 1995. As the multimedia interfaces adapt to user's demands and preferences the interactive matrix will automatically update and incorporate the changes in format.

6 How is the information inside the interactive matrix organised?

T4 interactive matrix is built so that a structured input ensures a consistent database f6 at. The established lower-tier authoring paradigm is such that data that does not conform will be rejected with reasons for the rejection. The author is then given the opportunity to modify the data and examples are displayed for his reference. The highertier authoring is for staff inputs and, should the author at this level wish to countermand the paradigm, then a password is necessary to breech the security check.

Generally all the data at the lower-tier level is 'soft' i.e. of a volatile nature stored on a local server. This permits easy modifications and amendments to the working database and to prevent major losses a mirror database is stored on a remote server. Once the data is checked and established it is shifted to the higher-tier where, in effect, it becomes 'hard'. This hard data may be stored in a number of formats e.g. secure disk storage, CD-ROM, laserdisc, etc. and may also contain some of the soft data in temporary duplications. By down loading and duplicating this hard data authors at the lower-tier can modify or add to the database and in some cases can export it to a totally new environment such as the virtual reality system that the Department of Architecture has recently installed.

The matrix relies on this structured input to allow the information to be retrieved in a logical and interlinked manner. The matrix, with its previously described axes, follows a building sequence for the elements of the Building Components axis a logical time format for the Time Frame axis and a legal order for the Regulation Subsets. Thus when a coordinate is specified inside the matrix a triple order is invoked [Subsets/ Item=X, Component/Attribute=Y, Time Frame/Regulation=Z]. This node contains information on how Z rules X which is a member of Y. The information can be a text description of how Z governs X and some linkages to other related materials not immediately apparent e.g. measured drawings and photos of instances of X created under the influence of Z. The proposed relationships of Regulations, Attributes and Items is shown in [Figures 7 and 8].

7 Source materials

One of the primary sources of data for this matrix is found in the report, "A Summary of the Hong Kong Building Regulations which Affect Housing Use" by Brian Sullivan and Elmer Olaer of the Department of Architecture, Chinese University of Hong Kong [1]. The report attempts to list all the Building Ordinances and Regulations that have applied in Hong Kong over the past century. A tabular form lists all concepts and

regulations with each entry indicating how a regulation affects an item or concept. Additionally, 2D drawings of front and side elevations plus photos of selected prototypical buildings for various periods have been included. This matrix has attempted to present this data in an interactive way. Additional sources have come from the Building Ordinance and Building Regulations Cap. 123 [2] as well as Authorized Persons Practice Notes [3] and Fire Services Circular Letters [4]. The original source for the diagrammatic representations is a report prepared by Fourth Year students in the Department of Architecture, University of Hong Kong [5].

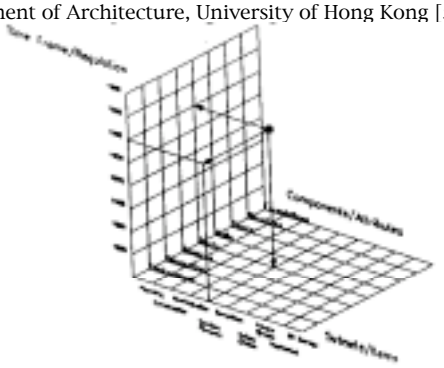

Figure 7 Subsets/Items-Components/Attributes-Time Frame/ Regulation

Figure 8 Invocation of a Triple Order

8 Endnotes

[1] This report takes an analytical approach to the complete history of Hong Kong Building Ordinances and Regulations

[2]This are the current Ordinance and Regulations issued by the Hong Kong Government Printer

[3], [4]These two sets of documents, technically, do not have the force of law but they represent the Building Authority's interpretation of the Regulations and are extremely powerful

[5]These exercises were carried out over a number of years and the collected holdings are held in the Architecture reference Bureau

9 Bibliography

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